Challenge #1, Material Handling

Each team will construct a robot that receives a standard 2 inch plastic LEGO ball from an adjacent robot and then passes that ball along to the next adjacent robot. These robots will be arranged in a rough circle and they will cooperate to continuously pass the ball around this circle, from robot to robot.

Background

There are over 6,000,000 industrial robots in use around the world and many are designed for material handling tasks. These robots often do work that's ill-suited for humans, such as spending 8 or more hours loading sacks of concrete onto pallets or picking up hot castings from a metal foundry. To accomplish these tasks, robots are often designed to work together so that an object can be passed from one place to another. These robots therefore communicate with each other to provide the collaborative effort and proper timing needed to perform their jobs.
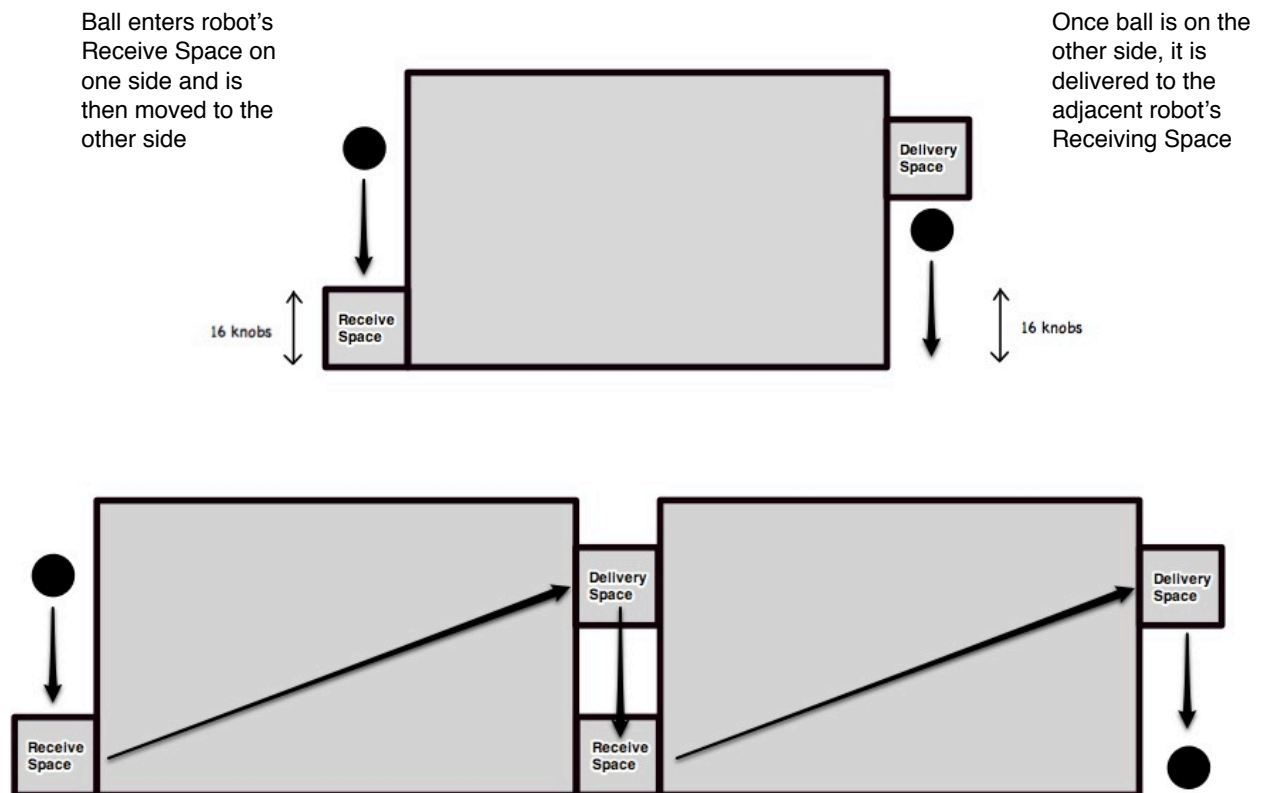
Details of this Challenge

- Each robot must be stationary

- Each robot must have a clearly visible name plate or flag attached to it that indicates its owner. This identification need not be a LEGO product.

- Each robot must be able to receive a standard 2 inch plastic LEGO ball at a height of less than 16 knobs above the surface.

- The receiving device may remain in the passing zone, provided it is not more than 16 knobs above the surface.

- The location at which the ball is received must be at least 2 inches away from the main body of the robot. No other parts may extend toward, or be within 2 inches of, the receiving station.

- The delivery device must, likewise, be at least 2 inches away from the the main body of the robot, with no other parts extending toward, or being within 2 inches of, the delivery device.

- Each robot must be able to pass this ball to the next robot by dropping it from a height greater than 16 knobs.

- Once the ball is delivered to an adjacent robot, the delivering device must move out of the drop zone within 5 seconds.

- Each robot must be able to sense when it has received the ball and then wait 5 seconds before actuating its own delivery.

- NXT and RCX robots may be used.

- Robot must be able to reset itself for the next delivery.

- Robots and their components must be stationary unless the robot:

    ‣ has received a delivery

    ‣ is making a delivery

    ‣ is resetting after a delivery

- Programs should be looped (run continuously)

- The overall success of this Challenge depends upon each team's robot collaborating with the other robots in the Challenge

- Size of the robot is not limited. However, keep in mind that there will be eight robots (teams) collaborating on this Challenge and the overall goal is to pass the ball around a circle such that the ball can continuously move around this circle of eight robots.

- Each team that has a successful design is encouraged to seek out other teams and collaborate with them as needed to make this Challenge successful.

- And now, some comments about non-LEGO parts such as rubber bands:

    ➡ Rubber bands may be added to standard LEGO pieces to aid the handling of the ball.

➡ Rubber bands may be used to provide a catch net.

◉ The robot must do all the work to move the ball along. Therefore, rubber bands may not be used:

➡ to spring-load parts of the robot

➡ for powering any part of the robot

➡ to serve as a slingshot mechanism

A general sketch of a Ball Handler Robot

Note: these sketches are provided for informational purposes only, to indicate the general location and height of the robot's Receive Space and Delivery Space.

Ball enters robot's Receive Space on one side and is then moved to the other side

Once ball is on the other side, it is delivered to the adjacent robot's Receiving Space

Delivery Space

Receive Space

16 knobs

16 knobs

Delivery Space

Receive Space

Delivery Space

Receive Space

Challenge #2, Remote Robot Race

Each team will pair two NXT's via Bluetooth such that one NXT will transmit driving instructions to a second NXT that traverses a driving course as quickly and error-free as possible.

Background

NXTs are remarkably capable robots and one of their more interesting abilities is to communicate commands to each other via Bluetooth. In this Challenge, you'll pair two NXTs and compete in a timed trial to see how well your robot can navigate the race course.

Details of this Challenge

- Each driver will run through the race course twice. Your best time from these two runs will be recorded.

- The controller (person) must be inside the central space of the race course

- Any contact with the robot (robot is stuck and needs your assistance) will result in the robot being placed before whatever obstacle resulted in the contact and the robot must make it through the obstacle again. For example, if a robot were to fall from the bridge, the robot would be returned to just before the bridge for another attempt.

- In addition to the driver / controller, each team will provide a "resetter" to re-position their robot as needed should it become stuck, fall, or otherwise need to re-run a portion of the course.

- Robot and Controller must be Bluetooth-enabled NXTs

- No wires may connect the controller and robot

- Controls must be provided so that, at a minimum, the robot can steer, start, stop, back up, etc. Additional control capabilities are allowed as a team feels are necessary.

- All robot controls must be from the team's NXT remote control unit to their NXT mobile robot. No iPhone, LEGO remote control, or computer control are allowed.

- The Control NXT should be set to never turn off (to preserve the Bluetooth connection once it has been established).

- You will name your NXT with a unique name to prevent confusion at the Challenge (this is done from MindStorms software).

- The Mobile Robot Unit:

  - may not exceed 10 inches wide by 10 inches long (including its wires) and 9 inches in in height (it must be able to fit under the bridge without touching)

  - may utilize any configuration of LEGO wheels, motors, or treads

  - should be set to never turn off (to preserve the Bluetooth connection once it has been established)

  - should be given a unique name to prevent confusion at the Challenge (this is done from MindStorms software).

- The Race:

  - This is a time trial event and robots will be timed from "go" until they cross the finish line (one complete circuit around the race course).

  - Race length will be approximately 50-60 inches in length and square or rectangular in configuration.

  - The race circuit will have a tracked lane that the robots will need to stay within. This lane will be at least 2 feet wide.

  - Included in this lane will be at least the following:

- A section of slalom

- A section of maze (moveable barriers with at least 18 inches of clearance between walls)

- A bridge section to go under or, for extra points, to go over. This bridge will be approximately 4 feet long, 1 foot wide, and have a center height of 9 ½ inches. The bridge surface will be covered with a foam adhesive covering (special shelf paper)

- A LEGO pit to get through. This pit will be 1 inch deep by 24 inches wide by 12 inches long. There will be a 3 inch long by 1 inch high ramp into and out of the pit. The pit will be filled with 2x2 round LEGO bricks.

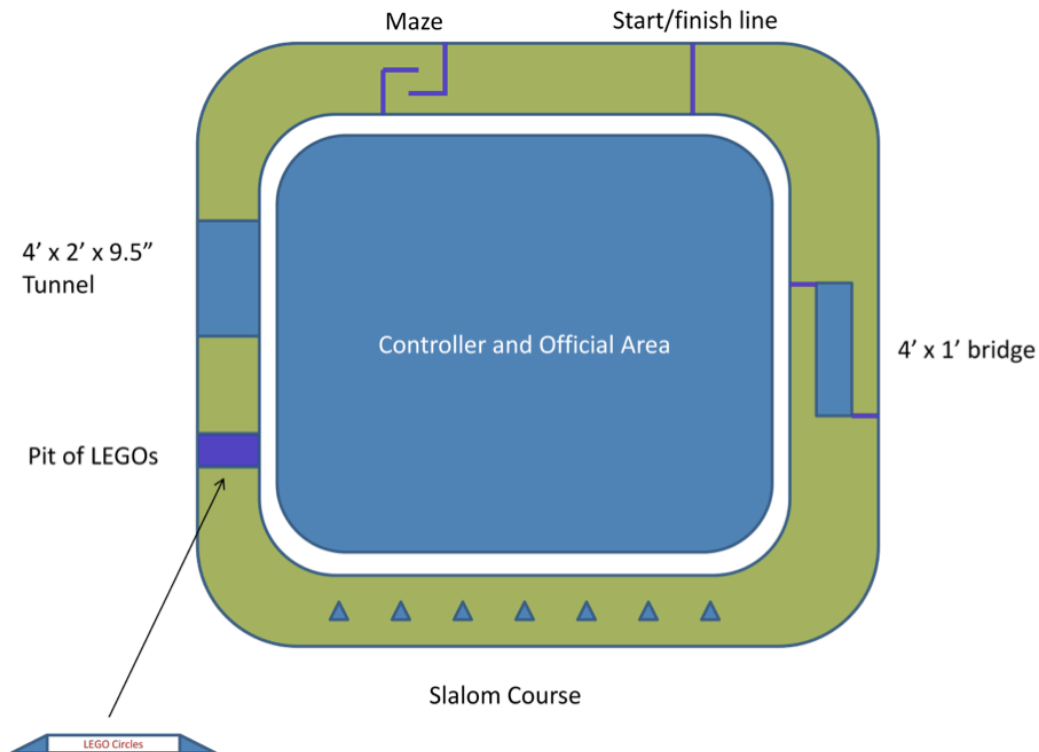- A 4 foot long by 2 foot wide and 9 ½ inch high tunnel that must be navigated blindly.

- Four corners to navigate.

Figure 2. Race Track Diagram.